KAREN FOLEY: Welcome back to the STEM showcase. Well, we're going to take a look now at the new geology curriculum. I'm joined by Tom Argles, who is currently the director of teaching in the School of Earth-- sorry, Environment, Earth, and Ecosystem Sciences. Got them the wrong way around. We normally say EEEs internally, and then I never know which E is first, but very topical.

Now, Tom's worked on for the last 20 years at the OU, and his research is mainly focused on minerals and melting in mountains. And he does lots of field work, as well. Now, what do you enjoy watching on your field work, Tom?

TOM ARGLES: All sorts of things. But generally, I mean, we get to some very remote places. So there's always fantastic wildlife. I've worked a lot in the Himalayas, as you said. So I've had students who've been watching bears, for example. There's lots of deer.

But I love watching birds. And you see the most amazing birds in the Himalayas, like incredibly brightly coloured pheasants. So it's a real privilege, actually, to do that work.

KAREN FOLEY: Absolutely.

TOM ARGLES: And lovely to hear that somebody else gets the Es the wrong way around. I've been doing this job now for about five years, and I still got them the wrong way around.

KAREN FOLEY: Yeah, no, I know. And that's why we have acronyms, which can be really good at hiding a multitude of sins sometimes. I hate that sometimes we would say, oh, what does that mean? And then you get the wrong word round. Anyway, we're here to talk about something that's of concern to everybody. And we've been talking a lot about sustainability and environment and some of the massive challenges that face our world, and how science, technology, engineering, and mathematics can help be part of, hopefully, a better future.

So Tom, this is something I wanted to talk to you about. And we have some things which we'd like you to fill in at home. Let us know on the scale, so you can pick where on the scale you'd like to be, where would you prefer to be after the COVID pandemic? And also, what are some of the key environmental concerns facing our planet?

Now, with these word clouds-- I am sorry, I didn't give you quite the right instructions. You can think of one, two, or three things, but you can't submit the same result. So if you put a full stop in one of the empty boxes, you need to put a cross in one of the empty boxes, or just a symbol or an icon, but not the same one, otherwise the results won't submit. So have a go at that, and we'll return to some of your thoughts in just a moment.

But Tom, what are some of the key challenges? And how can your specific area help us address some of those?

TOM ARGLES: Well, I mean, I think one of the things that's probably top of a lot of people's list would be rapid climate change. And we have a saying in geology, actually, that the present is the key to the past. So our science and scientists, geologists, spend a lot of time looking at the processes on the current Earth. And that gives them a clue to what went on in the past.

But in fact, I think we can turn that around for this topic and say, well, the past is actually the key to the present. And we have billions of years of a rock record in geology that we can interrogate. We can look back through millions and billions of years of climate change.

And we see through that time climate fluctuating. So temperature, CO2 levels, and so on, and we can record a lot of those. We can investigate a lot of those.

Most of the time, we see climate changing very, very gradually. It tends to change very gently. But there are a few periods in history, in Earth's history, where the climate change was very, very rapid.

And so geologists, I think, are looking at those periods now. We're studying those. We have researchers in our department studying those, as well, and looking to see, first of all, how it happened, but also why it happened. So what are the causes behind that were. And then also how the Earth system reacted. And getting clues from that, how the Earth system reacted, to how we can actually address those and possibly solutions to that.

So we're studying complex links in there. We're not just looking at the atmosphere with CO2 levels, but we're looking at the interaction with ocean chemistry and circulation. We're looking at the effect on plants and animals. So we're looking at evolution through time and extinction events.

So extinction events in the past, which mirror the sort of similar biodiversity crisis which is going on today. Another really big issue is-- sorry. Go on, Karen.

KAREN FOLEY: Oh no, I was just going to say, the really interesting thing I find about geology is you're talking about these massively long periods of times, and about considering very small processes of change within the Earth's long history. But there are other things that have changed dramatically that we may not have been able to anticipate. And one of the things that comes to mind is things like fossil fuels.

So some of the things are a lot more immediate and pressing in terms of how we get some of the resources that we're becoming to rely on so much.

TOM ARGLES: Yeah, that's very true. So the whole effort towards decarbonization of our society, and essentially moving from fossil fuels to cleaner energy, like maybe hydrogen or electrification and renewables. And I think geologists can do an awful lot there.

So we're looking into things like carbon capture. So sucking the carbon dioxide out of the atmosphere and storing it somewhere. And all the best options for storage for carbon dioxide and carbon in general are underground. They're in the geology of the planet, essentially.

And so we have pilot projects that are going on in, for instance, Iceland at the moment, looking at ways of putting the carbon dioxide underground and also fixing it in place. So we can use all the old oil wells and gas wells, for example, which are basically, essentially large holes in the ground that can actually suck up carbon dioxide and lock that away.

But in other cases, in other projects, we've got reaction cells in the ground. So we pump the carbon dioxide down into the ground, the subsurface, and it reacts with the rocks. You need the right type of rocks. You need a certain fluid to do that. And then you can lock that carbon away for a long period of time.

And in a sort of corollary of that, there's another project that we're involved in with enhanced weathering. So what that does is it crushes rocks up and spreads them on agricultural fields. This can be done all over the world. It's extremely low tech. And the natural weathering processes then actually draw carbon dioxide out of the atmosphere as it reacts with the rocks.

But you need a bit of geology for that because you need to know the right type of rock. So I've got a prop. There we go. I'm not sure this is going to work very well, but this is a rock that is very local to me. This is a Jurassic limestone that's about-- you talked about time-- about 180 million years old or so.

This is made of carbonate, calcium carbonate, and it will break down quite nicely if you spread it on the fields. Crush it up and spread it on the fields. It breaks down quite quickly. It'll dissolve in rainwater. And it'll suck in some carbon dioxide out of the atmosphere as it does so.

But the problem is, as it breaks down and weathers, it rereleases some of that carbon dioxide. So we need a different type of rock because that won't actually reduce the carbon dioxide. We need a rock like this. This is an igneous rock. It's a basalt.

And if we crush this up, again, it will weather very quickly, which is great, and it will draw carbon dioxide out of the atmosphere, but it won't rerelease it. So it locks that carbon dioxide away. And as a natural benefit, you also get a whole bunch of really useful nutrients that are locked away in the basalt that are then spread across the fields and go into the soil and actually help increase the crop yields, which is really great news.

So yeah, I think the geologists have a lot of work that they can contribute to these kind of question of resources all over the world.

KAREN FOLEY: And I haven't met a geologist yet who doesn't come up with an amazing range of rocks to show us. And Nick was telling us earlier about how we got access to some really important finds earlier. But tell us, Tom, then, I mean, in terms of becoming a geologist, what do students study in this degree? And is it mainly about rocks and fossils and minerals and the like?

TOM ARGLES: No, it's definitely not all about those. But I have to say that rocks, minerals, and fossils, they are core to the curriculum in many ways. We like to say that every rock has a story. And I think this is what prompts every geologist you've ever met to pick up a rock and start telling you their story, basically.

So we do do-- a lot of the core work in the curriculum is looking at the stories in the rocks. And those stories can be about the history of life on Earth. We have a whole bunch of different fossils that you can look at to look way back through billions of years of Earth history and a look at how life evolved.

But rocks like-- particularly, for instance, like the basalt that I was holding up earlier. That basalt has a record of a volcanic eruption in it. That was a volcanic eruption in the past. And some of those rocks will tell us about periods of time of several millions of years of continuous volcanic eruptions. And those volcanic eruptions might, for instance, have caused the extinction of things like the dinosaurs, for example. So past extinction events. And of course, we've talked about the rock record of climate change back through billions of years.

The key thing with all of this is observation. So what we ask the students to do in the curriculum, in the modules, is observe very closely. And that can happen out in the field, outdoors. It can happen in the lab. It can happen in their back gardens, if they like. If they're lucky enough to have rocks in their back gardens.

And we also take them down to the microscopic scale, as well. So the whole range of scales, right from the planetary scale down to the microscopic scale. And it's a whole mix of different sciences, as well.

So we've talked about it not just being about rocks, minerals, and fossils. We've got the chemistry of the minerals. We've got the chemistry of the ocean. We've got the physics of ocean circulation. We've got biological cycles that shape the environment and the impact of the environment on those biological cycles and those organisms.

And then, right at the base of it all, as well, just along the way, we have maths as well kicking in. Because one of the things about geology and environmental science is that the natural sciences are quite messy. And if you go out and collect data in the field or even in the lab from rocks and other environmental materials, the data you tend to get is quite messy. It's not very structured and rigid and so on. It's quite noisy.

And so you actually need some decent math skills, some good statistics, to try and disentangle all that noise and get to the key patterns within that data. So we do an awful lot of that kind of crossing across the whole boundaries of different sciences. And at the heart of the curriculum, really, is problem-solving.

So we start at the lowest stages, stage one and two, building up a sort of bank of knowledge in these different sciences, and then focusing in on the geology. But as we go through stages two and three, what we do more and more is we allow students to kind of synthesise that data to put together a whole range of different observations and data sets that they've collected and that we give them. And from those bases, they then start to try and solve problems for themselves.

So they might be looking at, for instance, managing risks from hazards, like volcanoes or earthquakes. In one module, for example, they even get to do a bit of modelling of climate with a kind of medium complexity climate model. And they'll also be gathering data themselves and testing out solutions for sustainabil-- oh, that's going to be a tricky word. Sustainability. So we are writing a new module at the moment for stage three, which is looking specifically on the theme of sustainability, again, across lots of different topics.

KAREN FOLEY: And these are all things that are newly present. I mean, the sustainability agenda is absolutely front of mind right now. Beryl says, "S209 was amazing. Hard but excellent." And earlier, I think to sort of demonstrate some of these complexities, Tom, we asked people where on the scale they would prefer to be after the COVID pandemic. Because one of the things that we were talking about before is that when some problems emerge, so do other problems. And it's the case where geology can sort of try to tackle massive changes.

So let's see what people said about whether they'd prefer to work from home or commute in an electric car. So that's your only option, I'm afraid, the binary here. But let's see what people said.

Most people prefer to work from home. Maybe they don't like electric cars as such. But Tom, this issue of limited, finite resources and our ability to sort of solve some problems as we have problems with, for example, saving money on fuel, saving the environment from fossil fuel usage, et cetera, we have other issues, as well. So there's this balance that I guess, is important to consider.

TOM ARGLES: Yeah, that's a really interesting result on the poll there. But I guess what it tells us is that we have an audience mainly of OU students who are very used to working at home, which is fair enough. But as you say, these kind of issues are raised. And of course, it gets involved with politics.

So part of the reason that I posed that question with the electric car option was because there's a very strong steer at the moment from the government on the fact that we are going to have to go electric, and that essentially all cars will be electric in the not-too-distant future, really. Certainly for a geologist, it's in the blink of an eye, really.

So we are going to have to come up with solutions for that. And one of the solutions that geologists are particularly interested in are the batteries for the electrification of the vehicles, for instance. And the batteries that run these vehicles at the moment run mainly on lithium. That's the kind of key element, the key metal, at the moment that we're searching for.

And in fact, I have a research student myself working on that problem at the moment as to where to find the lithium, where are the sources of lithium that we need to feed this massive increase in demand that's going to happen over the next few decades for electric cars. So that's a really interesting issue there that geologists can really contribute absolutely directly to.

KAREN FOLEY: Brilliant, OK. So in addition to searching for lithium, I wonder if we might return to the topic you mentioned before, which is about the sort of field and practical work. Now, one of the things that make studying with the Open University so wonderful is that students do get the opportunity to engage in incredible sorts of practical activities.

Now, you mentioned before some of your field trips. But before we go into those, what are some of the practical things that geology students may get involved with in their qualification?

TOM ARGLES: So I think often when people hear about geology, they think about fieldwork. And we do tend to be somewhat obsessed about fieldwork. I think a lot of geologists got into geology because they loved fieldwork. They loved being outdoors and working outdoors. And I think our students are lucky enough, despite it being a distance education degree, that we do give them opportunities to get out into the field.

So for instance, at stage two, there's a module where we have a field school which is just under a week in the Lake District. And that's, in fact, what you're looking at in the picture there. I can't guarantee the weather will always be quite as good as that, but it is quite surprising how often it doesn't rain. But yeah, so that's a field school up there. We look at a whole bunch of different rocks, some of them volcanic in the Lake District.

But we also, in the same module, have tutor-led field days. And on another module, as well. So those are led, of course, by tutors around the nations. And so there will almost inevitably be a field day or two which will be fairly close to you. And you can go and find out about your local rocks, or the rocks fairly close to where you live, in the company of a tutor.

There's also another field school in one of the environmental science modules. And although most of the places are reserved for the environmental science students, we are hoping that we could be able to get some of the Earth science students on there, as well.

I mentioned a new module, stage three, that we're writing at the moment focused on sustainability. But one of the features of that module will be a kind of empty box, what we call an empty box component. And that empty box will be for students to bring their own experience in.

So they might have gone on a field trip with an external provider, perhaps. A formal field course. They might have just done some fieldwork work on their own. They might have gone out on a field trip with the Open University Geological Society, which is a society with branches all across the UK and, in fact, in Europe.

They run trips not just in the UK and Europe, actually, but globally across the world. So they may have been on one of those trips or more than one of those trips and they want to actually bring that experience in, write it up. And they can put it in that empty box and gain some credit for it.

So that's the kind of fieldwork that we do. But it's, we realise, not everybody's cup of tea, fieldwork. Sometimes it does rain, and sometimes it gets a bit midgy, and so on and so forth. So there are lots of other practical options. And a lot of those, at the moment, are focused in an initiative. I don't know what you'd call it, quite. A thing at the OU, which is called the Open STEM Labs. And I think Helen is going to be joining you later, isn't she, to talk about them.

KAREN FOLEY: She absolutely is, yeah. We're going to find out lots about that.

TOM ARGLES: So from a geologist's point of view in the Open STEM Labs, we have virtual field trips. A couple of those are based in gaming engines. So you get a real sense of immersion, of really being there. And so one of those is based in the Lake District. But another one is a deep sea dive. So you get this sort of sense of being in a deep sea submersible.

We also have something called the digital kit, which presents virtual rock, mineral and fossil, specimens. And those are museum-grade specimens. So they're fantastic quality. They're really incredibly high quality. We've sourced those from our collections, but also from museums around the UK. And they are rendered in beautiful detail, including in 3D rotating videos, or also as 3D models that you can actually grab on the screen and rotate around.

We also have something called the virtual microscope, which is something that I'm the project leader on just at the moment. And that allows OU students access to over 1,000 samples, different rocks and samples of meteorites. Quite rare meteorites. And also a whole bunch of NASA samples from the Apollo missions, which, again, are really quite rare. So it opens up a whole sphere of access that really is very, very unusual. And that allows the students to make these fantastic microscopic observations.

KAREN FOLEY: And Nick mentioned in the start of the session today, Tom, that one of your colleagues got access to the Winchcombe meteorite.

TOM ARGLES: Yeah, so that's absolutely true. So earlier this year, a meteorite fell in Winchcombe, or near or around Winchcombe. And in fact, one of our researchers, Richard Greenwood in physical sciences, he was the first on the scene to actually identify the meteorite.

This was the one-- you probably saw a picture of it on the news, I think-- that went splat onto somebody's driveway and made quite a bit of a mess. And the interesting thing about the meteorite was that it was a very rare type of meteorite for the UK. So it's the first carbonaceous chondrite that's actually been found in the UK.

That type of meteorite has, as might be suggestive in the name, that it's got a lot of carbon in it. And that's really why it made a big splat and just looked like somebody had dropped a bunch of coal or something on the driveway. So yeah, we are hoping to secure a sample of that later on in the year and put that on the virtual microscope, as well.

And I'm quite excited about that. But we're in touch with the Natural History Museum about that, and hoping to be able to put that on later in the year.

KAREN FOLEY: And it's exciting because our students have access to really high-quality samples that they can then access online through something like the digital microscope. And some of these skills are really important. They're geographic information systems skills I hear are in quite high demand as a sort of employability attribute.

TOM ARGLES: Yep, that's absolutely true. So again, in this new module that we're writing at stage three, we're going to be introducing GIS skills into the curriculum for the first time, really. And again, that will be framed around solving problems, particularly to do with sustainability, so that students will be able to access data online, again, through the kind of portal that we're going to use. It's going to be through a web browser.

So they won't need any big, fancy, horrible, confusing software, we hope. It's just going to be through a web browser, and it should run through the web browser. So that's an advantage, I think. But it will allow them-- it'll open up a window to all sorts of data right across the world.

Data on elephant sightings, for example. Data on crimes. Data on, I mean, virtually anything you can put your mind to, really. And they'll be able to analyse and put together and compare all this data in their GIS setting, in the GIS software.

And you're absolutely right. So we've got a lot of queries from students more recently, I think, about this because so many employers are asking for those geographic information skills in all sorts of different walks of life. So it's not just in environmental or Earth science. It's right the way across to local government. And all sorts of other types of careers are looking at this as being a key skill to help them plot and plan, and assess risk, and so on.

KAREN FOLEY: Brilliant. And Tom, you've already spoken about the ways in which students can develop their own practical work, look at particular areas or rocks of interest in places nearby to them. But there is that wonderful flexibility for students to be able to focus on developing their practical work. You've mentioned the empty box module, but there are plenty more opportunities there.

It's all we've got time for, I'm afraid. But I just wanted to finish by some of the key environmental concerns that students spoke about facing our planet. And I think this will really hopefully sum up how integrated geology is. You've mentioned so many of the different disciplines.

Tom, here we can see that global warming is the key thing, but also other areas of interest, like food security, sustainability, fossil fuel resource, topsoil erosion, animal agriculture, sea level rise, deforestation, plastic waste, marine pollution, oil industry, recycling plastics, industrialization, throw-away community. So many brilliant things here that we can sort of see on screen.

Tom, I wonder if you just might want to sum up in a few words, I mean, what are you going to do then? There are so many questions here. We've seen some areas of focus that are really important for geology to work on. How might you like to sum up the session?

TOM ARGLES: Yeah, I mean, that's fantastic to see all that range of issues that people are concerned about. I think we've really got our work cut out, haven't we? But I think what geology is very good at-- you talked about this huge range of time. I think the other thing it's very good at is working at different scales.

So that's one of the things that I think geologists in particular are excellent at, is working right the way down from the microscale, right the way up to the global, and even beyond. There's a planetary scale, if you like. And I think that's a key thing for geologists, and it's a key skill that they come out of a degree in geology with, is that ability to just move across different scales and draw data and solutions from different scales to actually solve problems at their local and everyday scale.

KAREN FOLEY: Absolutely, absolutely. Well, Tom, that's been absolutely incredible. Thank you so much for coming along today. And I'm sure everyone's found that really enjoyable and is going to find out more.

But we're going to show you a video now which is about Tom's field trip on S209. Then we will be back to look at computing and communications. So stay with us, and I'll see you in just a moment.

[MUSIC PLAYING]